

PI 4-2 probe interface



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Renishaw part no: H-1000-5004-04-B

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PI 4-2 interface

Installation guide



FCC

Information to users (FCC section 15.105)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

Information to the user (FCC section 15.21)

The user is cautioned that any changes or modifications not expressly approved by Renishaw plc or authorised representative could void the user's authority to operate the equipment.

Special accessories (FCC section 15.27)

The user is also cautioned that any peripheral device installed with this equipment such as a computer, must be connected with a high-quality shielded cable to insure compliance with FCC limits.

TÜV

This equipment has been independently certified by TÜV Product Services in accordance with OSHA (US) and SCC (Canada) requirements to the standards UL61010-1 Second Edition and CAN/CSA-C22-2 No. 61010-1 Second Edition.

Safety

Electrical requirement

If this product is not used in its intended manner, any protection provided may be impaired.

The PI 4-2 is powered from the a.c. mains supply via an IEC 320 connector. The electrical ratings of the unit are as follows:

100-240 V ac +10%, -15% 47 - 66 Hz 10 W

This equipment must be connected to a protective earth conductor via a three core mains (line) cable. The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. The protective earth contact shall not be negated by the use of an extension cable without protective conductor.



WARNING: Any interruption of the protective conductor may make the equipment dangerous. Make sure that the grounding requirements are strictly observed.

Environmental requirements

The following environmental conditions comply with (or exceed) BS EN 61010-1:1993:

Indoor use only	IP30 (no protection against water)
Altitude	Up to 2000 m
Operating temperature	0 °C to +50 °C
Storage temperature	-10 °C to +70 °C
Relative humidity	80% maximum for temperatures up to +31 °C Linear decreases to 50% at +40 °C
Transient voltages	Installation category II
Pollution degree	2

The PI 4-2 is isolated from AC power by disconnection of the IEC mains connector on the rear panel. If any additional means of isolation is required, it must be specified and fitted by the machine manufacturer or the installer of the product. The isolator must be sited within easy reach of the CMM operator and comply with IEC61010 and any applicable national wiring regulations for the country of installation.

Care of equipment

Renishaw probes and associated systems are precision tools used for obtaining precise measurements and must therefore be treated with care.

Changes to Renishaw products

Renishaw plc reserves the right to improve, change or modify its hardware or software without incurring any obligations to make changes to Renishaw equipment previously sold.

Warranty

Renishaw plc warrants its equipment provided that it is installed exactly as defined in associated Renishaw documentation.

Consent must be obtained from Renishaw if non-Renishaw equipment (e.g. interfaces and/or cabling) is used or substituted. Failure to comply with this will invalidate the Renishaw warranty.

Claims under warranty must be made from authorised services centres only, which may be advised by the supplier or distributor.

Patents

Features of Renishaw's PI 4-2 and associated products are the subjects of the following patents and patent applications:

EP 242747 B	JP 2,539,824	US 4769919	WO 97/35164
EP 279828 B	JP 2,647,881	US 4817362	
EP 0392660	JP 3,018,015	US 4916339	
EP 548328 B	JP 3,294,269	US 5,088,337	
EP 0501710	JP 3,279,317	US 5,404,649	
	JP 2,510,804	US 5,339,535	
		US 5,323,540	
		US 5,505,005	
		US 5,918,378	
		US 6012230	

Contents

1	Introduction and general description.....	7
2	Specification	9
2.1	Physical specification	9
2.2	Environmental conditions	9
2.3	Electrical specification	10
3	Unit configuration	11
3.1	Front panel.....	11
3.2	Rear panel.....	12
4	System configuration	16
4.1	System interconnection diagrams	16
4.2	Cables	19
4.2.1	PL22T	19
4.2.2	PL25T	19
4.2.3	PL26T	20
4.2.4	HC-2 hand control	20
4.2.5	PICS	21
4.2.6	STOP (pin 1).....	22
4.2.7	PPOFF (pin 2)	22
4.2.8	0 V (pin 3)	22
4.2.9	+5 V (output pin 4)	23
4.2.10	SYNC (output pin 5)	23
4.2.11	HALT (output pin 6).....	23
4.2.12	PDAMP (pin 7).....	23
4.2.13	LEDOFF (pin 8)	24
4.2.14	LED anode (input pin 4).....	24
4.2.15	PICS pull-up (input pin 6)	24
4.2.16	Probe input (input pins 5 and 9)	24
4.2.17	Output timings	24

5	Rack mounting	26
5.1	Mounting alone in a 19" rack	26
5.2	Mounting next to a PHC10-2	27
6	Maintenance	28
7	Fault finding	29
7.1	POWER ON LED will not light	29
7.2	PROBE SEATED LED will not light	29
7.3	PROBE SEATED LED remains on	30
7.4	PROBE SEATED LED correctly lit but output signals fail to reach CMM controller.....	31

1 Introduction and general description

The function of a probe interface is to manage the probe to ensure that it produces repeatable and reliable results over a long service life. This is achieved by careful control of the probe current, trigger threshold and signal conditioning. A probe interface also controls the head PROBE STATUS LED and provides clean output signals.

The PI 4-2 is a basic probe interface for use with Renishaw's conventional touch-trigger probes (TP1, TP20, TP6, MH20i etc.). It is suitable for use on both manual and direct computer control (DCC) co-ordinate measuring machines (CMMs).

The PI 4-2 has been introduced as a replacement for the PI 4, PI 9 and PI 12 interfaces and conforms to the relevant CE directives in force at the time of issue. It is housed in the modern Renishaw enclosure compatible with the latest PHC10-2 and other controller/interfaces.

The PI 4-2 interface has both solid state relay (SSR) and Renishaw product inter-connection system (PICS) output options. It will also support the remote inhibit hand control unit (HC-2).

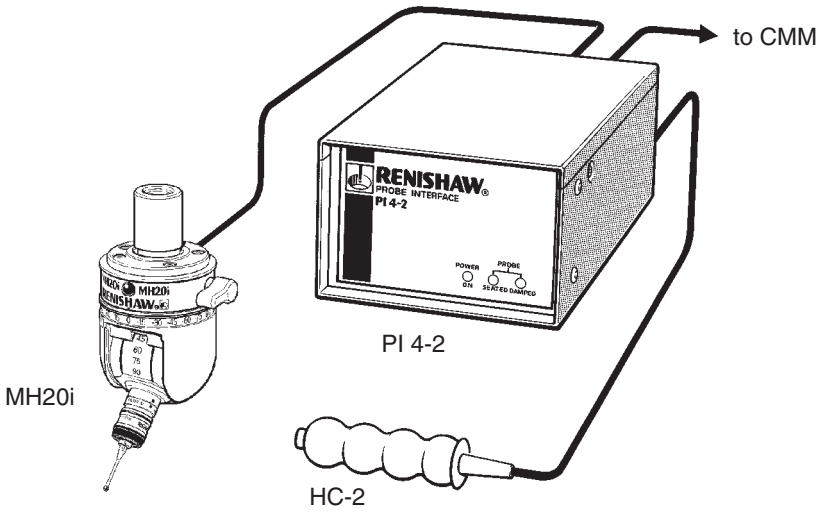


Figure 1

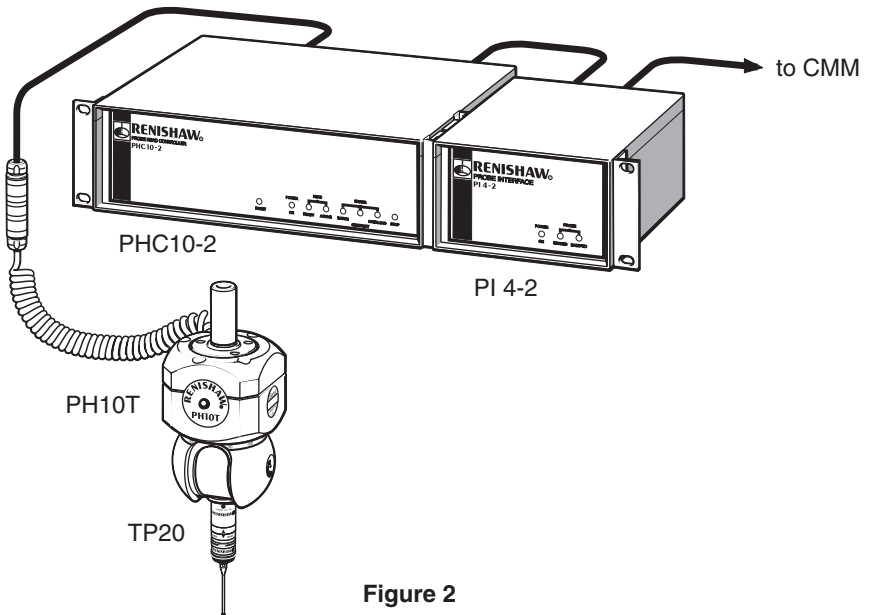


Figure 2

2 Specification

2.1 Physical specification

Size	1/3 19 " rack wide × 2U high (140 mm × 88 mm × 183 mm high)
Mounting	19 " rack mounting or free standing
Weight	1.6 kg (3.5 lb)
Probe compatibility	Standard probes: TP1, TP20, TP6, MH20i, etc.
Power connector	IEC 320
Probe input connector	9-way D socket (Renishaw PICS standard)
Probe output connector	9-way D plug (Renishaw PICS standard) or 5-pin DIN SSR socket
System configuration	4 DIL switches
Probe signal cable	50 m, maximum at 24 AWG cores

2.2 Environmental conditions

The following environmental conditions comply with (or exceed) BS EN61010-1:1993

Indoor use only	IP30 (no protection against water)
Altitude	Up to 2000 m
Operating temperature	0 °C to +50 °C
Storage temperature	-10 °C to +70 °C
Relative humidity	80% maximum for temperatures up to +31 °C Linear decreases to 50% at +40 °C
Transient voltages	Installation category II
Pollution degree	2

2.3 Electrical specification

Mains power is supplied on a standard IEC 320 connector.

Power supply	Universal, automatic selection; 100-240 V ac +10%, -15%, 47-66 Hz
Power consumption	10 W maximum (0.1 A maximum)
Inrush current	40 A, typical at 200 V
SSR contact ratings	±50 V pk ±40 mA pk

NOTE: The PI 4-2 must be earthed.

3 Unit configuration

3.1 Front panel

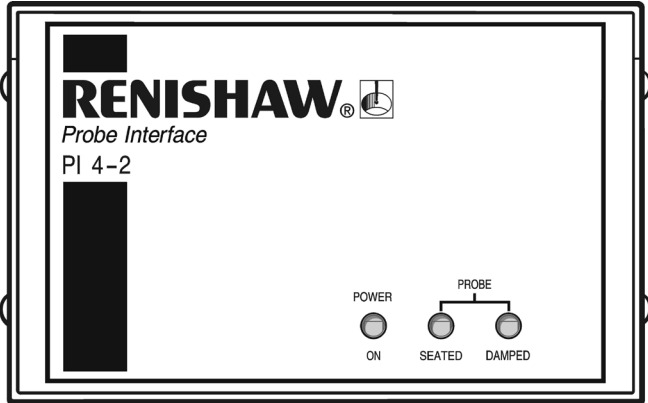


Figure 3

The name, colour and function of the LEDs are given in table 1.

Table 1 - Interface LEDs		
Name	Colour	Function
Power ON	Green	Mains power ON when lit.
Probe SEATED	Green	Probe seated when lit. Probe triggered or not fitted when off.
Probe DAMPED	Yellow	Lit when PROBE DAMPING has been activated by the CMM controller or other Renishaw equipment (PROBE DAMPING reduces the sensitivity of the probe to unwanted triggers caused by CMM acceleration or vibration during position moves).

3.2 Rear panel

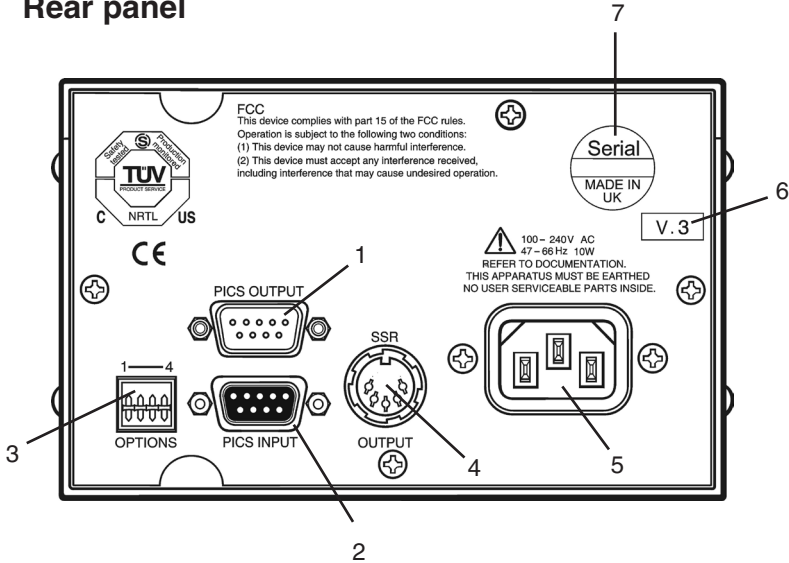
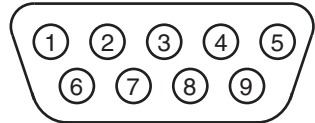


Figure 4

1 PICS output connector (plug)

The plug configuration is shown below and the pin numbers and designations are given in table 2.

Table 2 - PICS output connector	
Pin number	Designation
1	STOP
2	Probe power OFF (PPOFF)
3	0 V
4	Reserved for Renishaw use
5	SYNC output (probe trigger)
6	HALT output
7	PROBE DAMPing (PDAMP)
8	LED OFF
9	-
Body	Screen

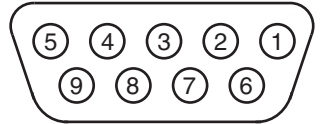


See page 27, 'Product inter-connection system (PICS)' for explanation of PICS signals.

2 PICS input connector (socket)

The socket configuration is shown below and the pin numbers and designations are given in table 3.

Pin number	Designation
1	STOP
2	Probe power OFF (PPOFF)
3	0 V
4	Reserved for Renishaw use
5	Probe signal
6	+5 V
7	PROBE DAMPing (PDAMP)
8	LED OFF
9	Probe return
Body	Screen



See page 27, 'Product inter-connection system (PICS)' for explanation of PICS signals.

3 Configuration switches

Switch numbers, positions and designations are given in table 4 (on page 22).

Table 4 - Configuration switches		
Switch number	Position	Designation
1	Up (ON)	Output polarity normal: SYNC high for probe seated, low for probe triggered SSR open for probe seated, closed for probe triggered
	Down (OFF)	Output polarity reversed
2	Up (ON)	Buzzer ON
	Down (OFF)	Buzzer OFF
3 and 4 *	Up (ON)	Input polarity normal: PICS input: Pin 5 = probe input Pin 9 = 0 V return
	Down (OFF)	Input polarity reversed: PICS input: Pin 5 = 0 V return Pin 9 = probe input

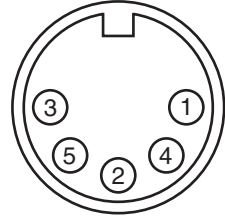
* Switches 3 and 4 must be used together (i.e. BOTH up or BOTH down).

** Although, conventional touch-trigger probes are not polarity sensitive, certain grounding systems or special probes may require the operation of this switch.

4 SSR output (5 pin DIN socket)

The socket configuration is shown below and the pin numbers and designations are given in table 5.

Pin number	Designation
1	Probe status (a)
2	Screen
3	Probe status (b)
4	Probe status (a)
5	Probe status (b)



NOTE: The probe status SSR output is connected to pins 1 and 3 and to pins 4 and 5.

5 Mains power connector

This is a standard input plug conforming to IEC 320.

6 Version number label

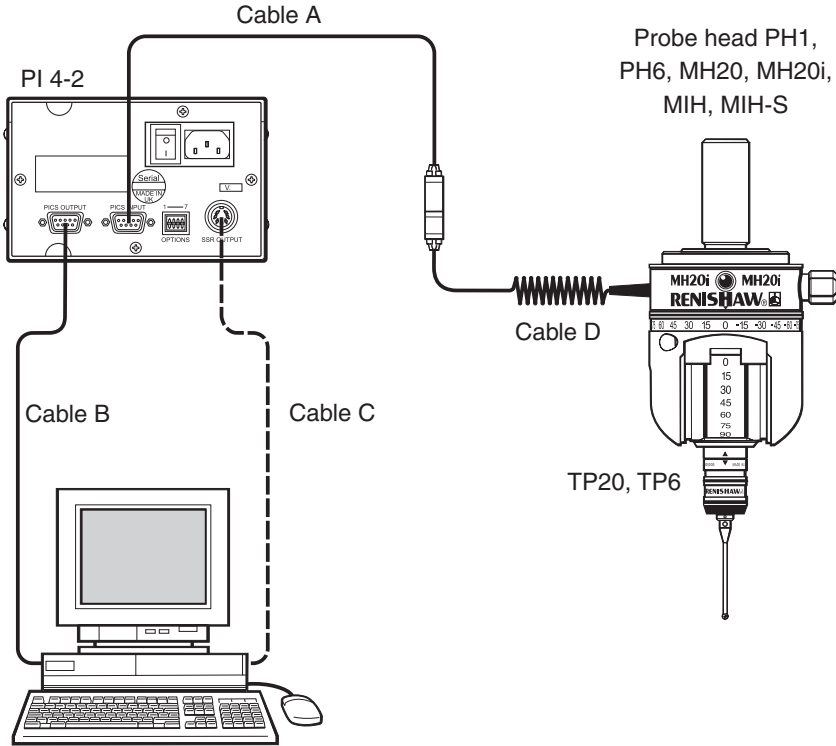
This label indicates the modification level of the interface. The information may be relevant when compatibility with other systems is being considered and should always be quoted when contacting Renishaw for help or service.

7 Serial number

This unique number allocated to your PI 4-2 should be quoted when contacting Renishaw for help or service.

4 System configuration

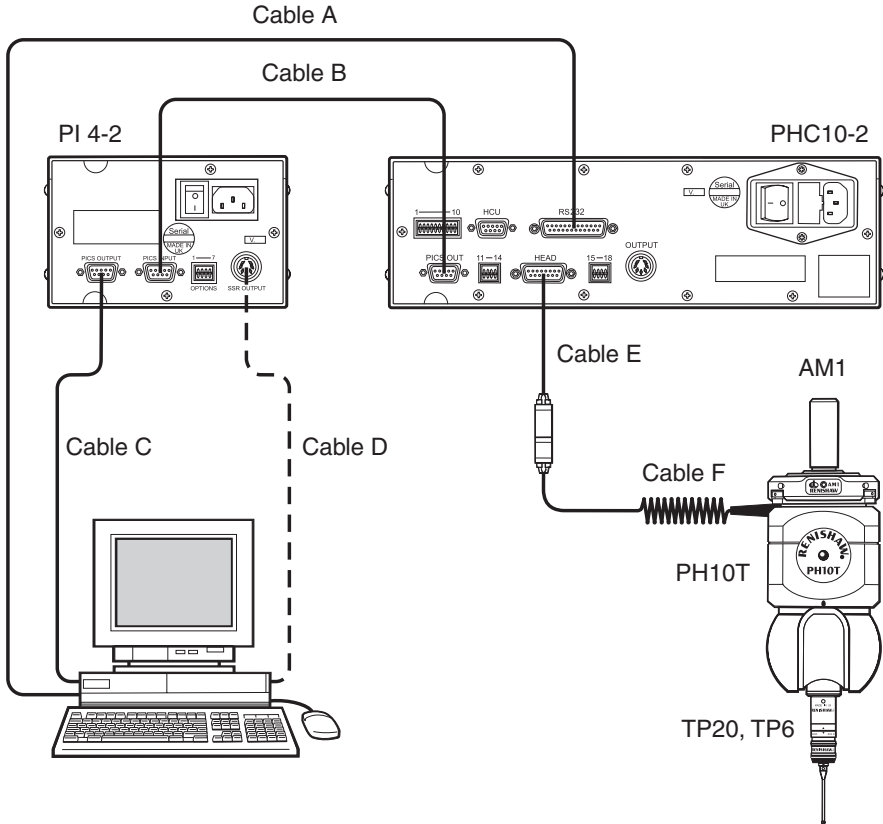
4.1 System interconnection diagrams



Cable A	PL22T
Cable B	PICS output to CMM (or HC-2)
Cable C	SRR output to CMM
Cable D	PL1T, 2T, 3T, 4T

NOTE: The cable shown is an alternative output cable.

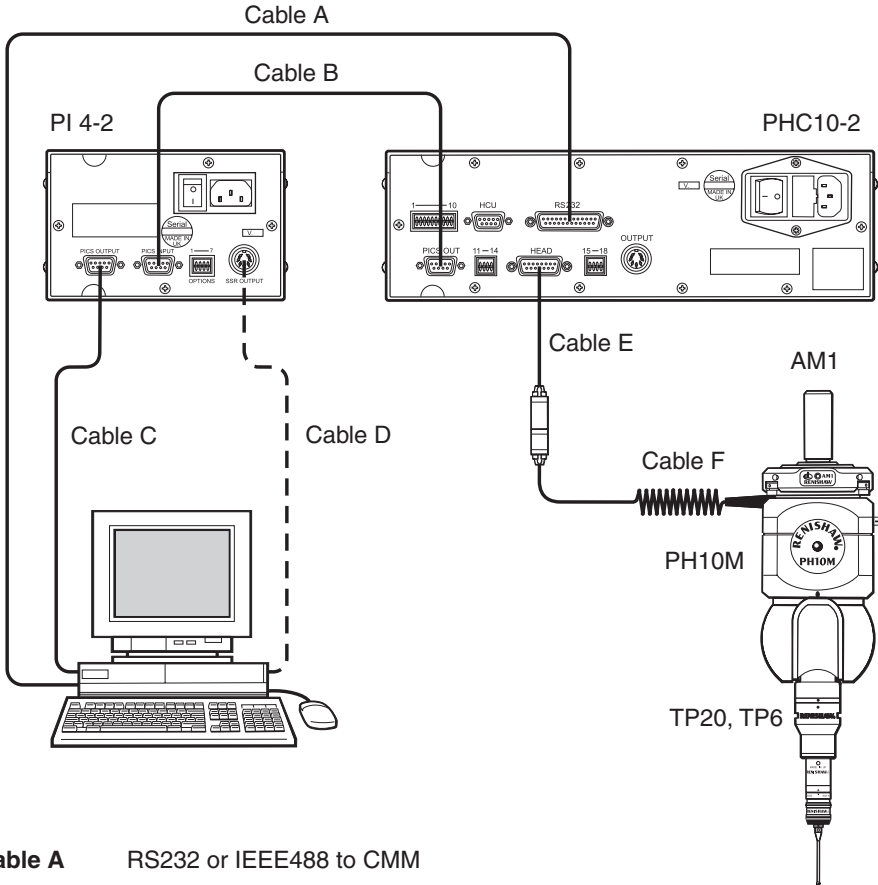
Figure 5 - PI 4-2 with manual heads



- Cable A** RS232 or IEEE488 to CMM
- Cable B** PL25T
- Cable C** PICS output to CMM
- Cable D** SSR output to CMM
- Cable E** PLM 6T, 7T, 8T, 9T
- Cable F** PL5T, 6T, 12T, 13T

NOTE: The cable shown is an alternative output cable.

Figure 6 - PI 4-2 with PH10T and PHC10-2 controller



- Cable A** RS232 or IEEE488 to CMM
- Cable B** PL25T
- Cable C** PICS output to CMM
- Cable D** SSR output to CMM
- Cable E** PLM 6T, 7T, 8T, 9T
- Cable F** PL5T, 6T, 12T, 13T

NOTE: The cable shown is an alternative output cable.

Figure 7 - PI 4-2 with PH10-M and PHC10-2 controller

4.2 Cables

Three conventional cables can be used with the PI 4-2: -

- PL22T
- PL25T
- PL26T

Their functions and connections are given below.

4.2.1 PL22T

The PL22T adapts a 5 pin DIN input connector into a 9-pin D-type PICS input.

The 5-pin DIN end is a socket which allows a PI 4-2 input cable to be adapted to a PICS input (see figure 8).

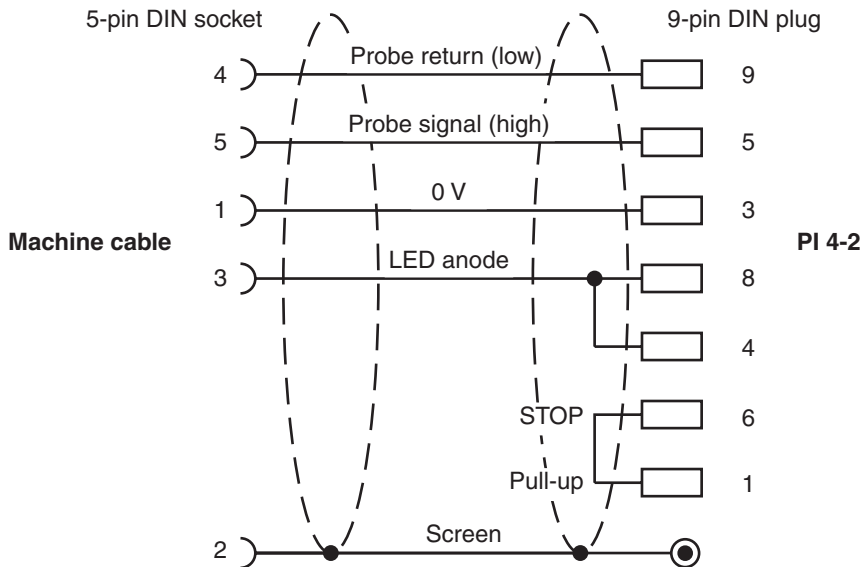


Figure 8

4.2.2 PL25T

The PL25T is a standard PICS interconnection cable 9-pin D plug to 9-pin D socket. All connections are pin-to-pin (i.e. 1 to 1, 2 to 2 etc.).

4.2.3 PL26T

The PL26T cable connects between the 7-pin DIN probe output of a PHC10-2 and the 9-pin D type PICS input of the PI 4-2 (see figure 9).

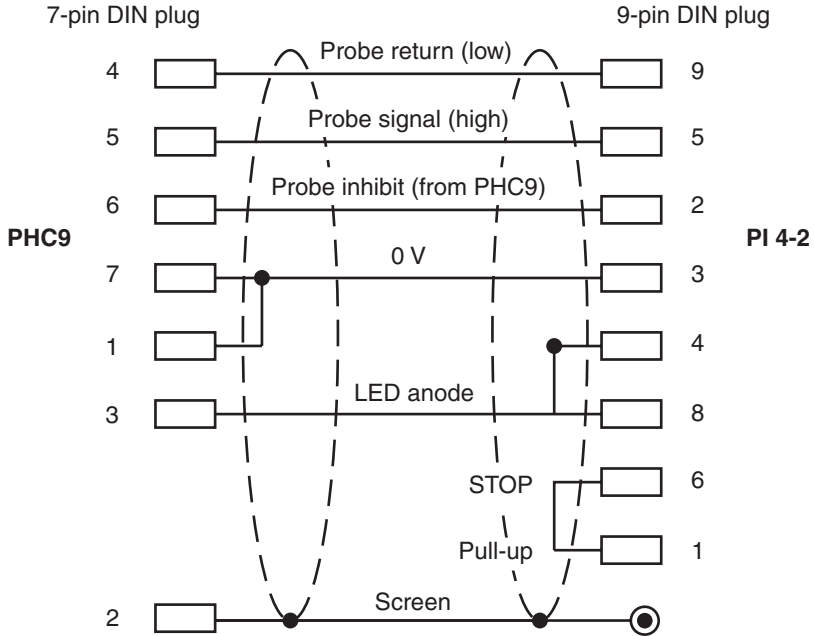


Figure 9

4.2.4 HC-2 hand control

The HC-2 hand control (figure 10) is a simple remote inhibit switch which allows the machine operator to inhibit the interface while the stylus is changed or the probe head indexed. It has an LED indicator in the switch button which is lit when the interface is inhibited.

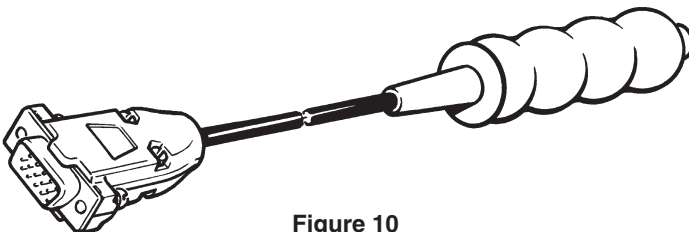
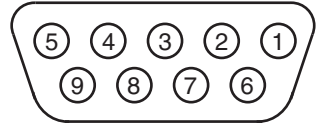


Figure 10

The HC-2 is intended for use only on manual CMMs and is plugged into the PICS output connector (see page 18, “Rear panel”)

The socket configuration is shown below and the pin numbers and designations are given in table 6.

Pin number	Designation
1	-
2	SWITCH (high)
3	0 V
4	LED drive
5	-
6	Screen
7	-
8	-
9	-
Body	-



4.2.5 PICS

The product inter-connection system (PICS) has been developed by Renishaw to simplify the number and variation of cables needed for installations comprising several controllers/interfaces.

PICS allows a standard method of connection for all real time signals used by current Renishaw products.

The descriptions given in the following sections are specific to PI 4-2 connections.

For a full explanation of the PICS system see the Renishaw publication PICS installation guide (part number H-1000-5000).

Table 7 (on page 22) gives pin numbers and input and output functions.

Table 7 - PICS		
Pin number	PICS output	PICS input
1	STOP	STOP
2	PPOFF (probe power OFF)	PPOFF (probe power OFF)
3	0 V	0 V
4	Reserved for renishaw use	LED anode
5	SYNC	Probe signal (high)
6	HALT	PICS pull-up
7	PDAMP (probe DAMPing)	PDAMP (probe DAMPing)
8	LEDOFF	LEDOFF
9	-	Probe return (low)

4.2.6 STOP (pin 1)

This signal is active when low and is responded to, and can be asserted by, the PI 4-2 interface.

It is present on both input and output connectors.

STOP will be asserted only if the internal power rail of the PI 4-2 fails.

If another unit on the PICS bus asserts the stop signal, the PI 4-2 reacts by asserting both the SYNC and HALT lines irrespective of the status of any of the other PICS lines. This is carried out to ensure that CMM motion is stopped.

4.2.7 PPOFF (pin 2)

Probe power OFF is an active low inhibit signal produced by another unit on the PICS bus (the PI 4-2 cannot assert PPOFF).

It is present on both input and output connectors.

The PI 4-2 reacts to PPOFF by inhibiting the SYNC signal (i.e. the output if held high* irrespective of the probe status). STOP overrides the PPOFF signal.

4.2.8 0 V (pin 3)

This is the common reference and return path for all signals except the un-interfaced probe inputs on the PICS inputs connector. It is present on both input and output connectors.

4.2.9 +5 V (output pin 4)

This output is reserved for Renishaw use and consists of a limited +5 V supply to power certain signal conditioning units.

4.2.10 SYNC (output pin 5)

This is an active low* signal produced by the PI 4-2. It is the output of the probe status, a normally high* signal which goes low when the probe is triggered.

STOP and PPOFF override the output. STOP forces the signal low. PPOFF forces the signal high*.

It is present only on the PICS output connector.

4.2.11 HALT (output pin 6)

This is an active low signal produced by the PI 4-2.

It is present only on the PICS Output connector.

The PI 4-2 asserts HALT when the raw probe signal (before debounce) indicates that the probe has been continuously triggered for at least 5 ms (see figure 11 on page 31).

The function of this output is to indicate the difference between a short vibration trigger and a genuine trigger event. The scales should be latched when SYNC is received, the reading accepted and the machine stopped when HALT is received.

* These signals will be inverted if the output polarity switch (SW1) is in the DOWN position.

4.2.12 PDAMP (pin 7)

PROBE DAMPING is an active low signal produced by another unit on the PICS bus (the PI 4-2 cannot assert PDAMP).

It is present on both input and output connectors.

PDAMP influences the SYNC output by inhibiting it until the probe has been continuously triggered for at least 5 ms. Renishaw recommends that PDAMP is asserted by the CMM controller to reduce the probe's sensitivity to vibration during rapid position moves.

4.2.13 LEDOFF (pin 8)

This signal is active when low and can be asserted by the PI 4-2 or another unit in the PICS bus.

The PI 4-2 asserts LED OFF and the SYNC line at the same time in response to a trigger event or a STOP signal. The purpose of the LED OFF signal is to control the LED on the probe signal.

4.2.14 LED anode (input pin 4)

This is a 12 mA LED drive current produced by the PI 4-2 to control the probe head LED.

It is present on the PICS input only.

This output is connected to the LEDOFF signal at the probe head or its controller to control the LED.

4.2.15 PICS pull-up (input pin 6)

This is an 150 W pull-up resistor to +5 V and is used to provide a STOP pull-up for systems which do not have a probe head controller in the PICS bus.

4.2.16 Probe input (input pins 5 and 9)

These are the probe input connections to the PI 4-2.

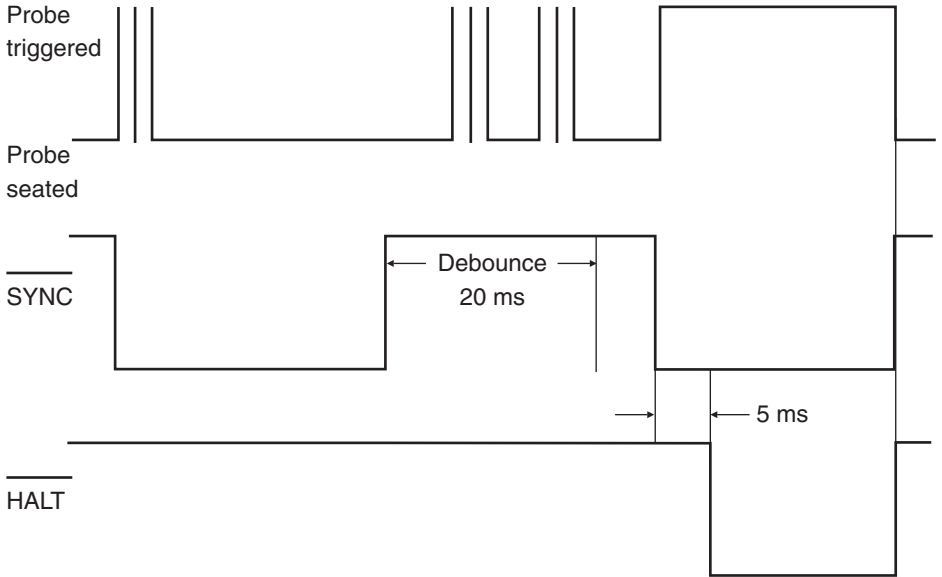
4.2.17 Output timings

Standard probe timing

Probe output timings for normal touch-trigger operation are shown in figure 11.

Probe DAMPing

When the probe DAMPing line is pulled low, SYNC will be sent only if the probe is triggered for longer than 5 ms (see figure 12).



NOTE: The HALT signal is a minimum of 20 ms long. If the signal is more than 5 ms but less than 25 ms these edges will not coincide.

Figure 11

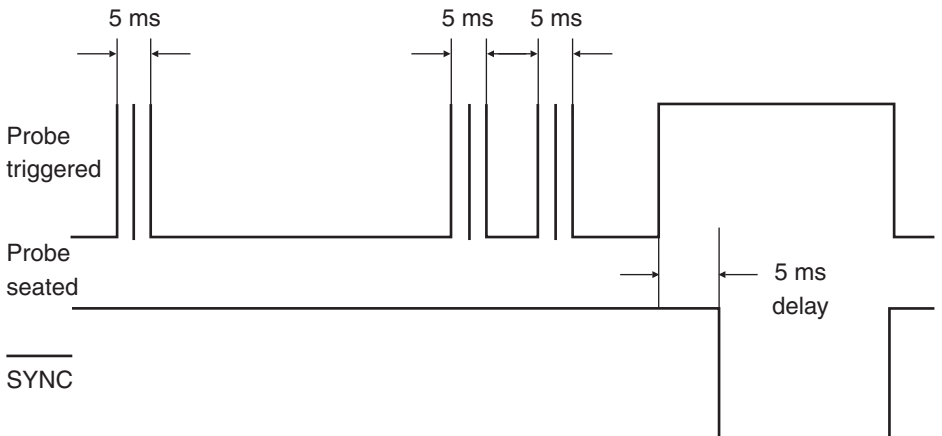


Figure 12

5 Rack mounting



WARNING: Ensure the PI 4-2 is disconnected from the mains supply during installation.



WARNING: Take care not to exceed the operation ambient of 50 °C around the unit. Do not install near sources of heat. Forced cooling may be required in final installation.

NOTE: Use the mounting screws supplied with this equipment. DO NOT replace with longer screws as damage could occur.

5.1 Mounting alone in a 19" rack

The PI 4-2 can be used in a 19" rack system or as a stand alone unit.

Figure 13 below shows a PI 4-2 mounted to a 19" rack system.

Remove the blanking plugs from side panels of the PI 4-2 and fit the 1/3 blanking panels (1) using the screws provided.

Fit the completed assembly to the rack.

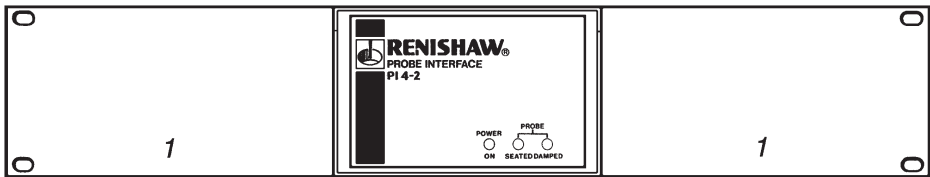


Figure 13

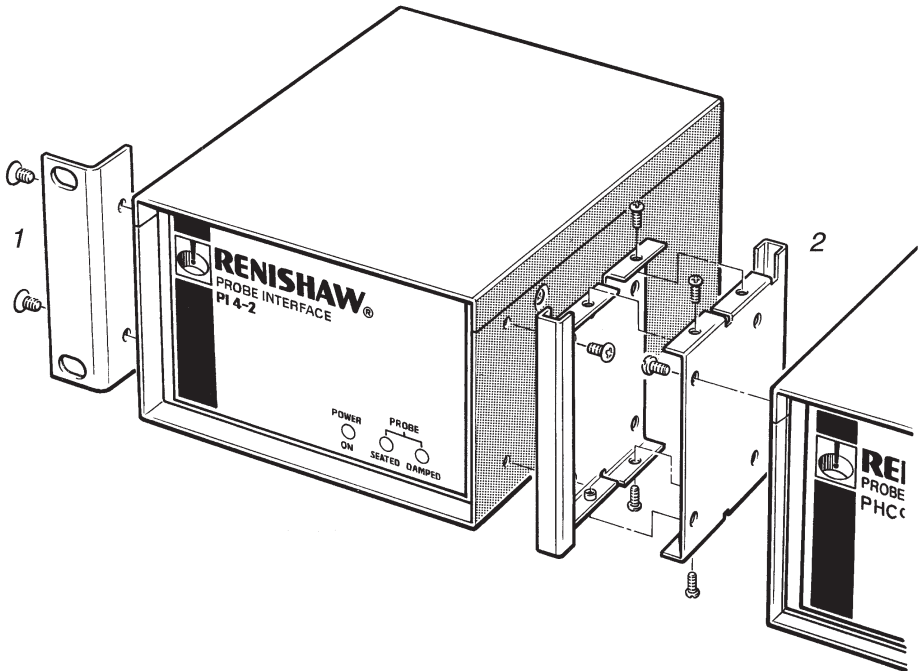
5.2 Mounting next to a PHC10-2

The 1/3 blanking panel kit part number is A-1018-0123.

Figure 14 (on page 26) shows the PI 4-2 mounted next to a PHC10-2. Fit a rack mount bracket (1) and an enclosure link bracket (2) using the screws provided.

Remove the blanking plugs from the PHC10-2 (if fitted) and, using the screws provided, fit an enclosure link bracket and a rack mount bracket.

The enclosure mount brackets must be fitted in the orientations shown. Fit the link brackets to the units before fitting the link brackets together. Using the screws provided, fit together to PI 4-2 and the PHC10-2. The complete linked assembly is ready for fitting to the rack.



The rack mounting bracket kit part no. A-1018-0124.

The enclosure link bracket kit part no. A-1018-0126.

Figure 14

6 Maintenance

There are no user serviceable parts within the PI 4-2.

The PI 4-2 may be wiped clean using a clean dry cloth.

7 Fault finding

There are several test which can be safely carried out while power to the PI 4-2 is on. DO not remove the cover in any circumstances.

7.1 POWER ON LED will not light

This will normally indicate that no power is applied to the unit (it is driven from an internal d.c. supply).

Check that:

- The mains power cable is firmly connected.
- There is mains power to the mains cable.

If these checks do not correct the problem the PI 4-2 should be returned to Renishaw for repair.

7.2 PROBE SEATED LED will not light

This will normally indicate that the probe is triggered or not connected.

Check that:

- The rear panel switches 3 and 4 are both up or both down (switches 3 and 4 must always be in the same position, see section 3.3)
- Disconnect the PICS input connector and put a link (short circuit) between pins 5 and 9 of the PI 4-2 input plug. Check that PROBE SEATED LED is still off.

If these checks do not isolate the problem the PI 4-2 should be returned to Renishaw for repair.

If the link (short circuit), described above, switches the PROBE SEATED LED on, the fault is in the input (CMM wiring, probe head or probe). See the appropriate product documentation.

7.3 PROBE SEATED LED remains on

This will normally indicate that the probe is seated.

Check that:

- The LED goes off when the PICS Input connector is removed.
- The LED goes off when the HC-2 is disconnected (if fitted).

If removing the PICS Input connector switches the PROBE SEATED LED off, the fault is in the input (CMM wiring, probe head or probe). See the appropriate product documentation.

If removing the HC-2 input (when not set to inhibit), switches the PROBE SEATED LED off, the problem is in the HC-2 (which should be returned to Renishaw for repair).

If these checks do not isolate the problem the PI 4-2 should be returned to Renishaw for repair.

7.4 PROBE SEATED LED correctly lit but output signals fail to reach CMM controller

Perform the following procedures -

1. Remove the PICS output connector.
2. Using a voltmeter connected between pin 3 (0 V) and pin 5 (SYNC) on the PICS output socket.

When the stylus is seated the output voltage should be between 4 V and 5 V d.c. When the stylus is deflected the output voltage should be between 0 V and 1 V d.c. If switch 1 is DOWN the output voltages will be reversed (i.e. 0 V seated, 5 V deflected).

OR, if the SSR output is being used:

1. Remove the SSR output connector.
2. Using a resistance meter connect the pin 1 (probe status, a) and pin 3 (probe status, b).

When the stylus is seated the resistance should be less than 10 Ω . When the stylus is deflected the resistance should be greater than 1 M Ω . If switch 1 is DOWN the resistances will be reversed (i.e. more than 1 M Ω seated, less than 10 Ω deflected).

If these checks do not correct the problem the PI 4-2 should be returned to Renishaw for repair, otherwise the fault is either in the output cable or the CMM controller input (see the appropriate product documentation).

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